

cellular or physiological response, metals, gases, minerals, ions, and electrically, magnetically and electromagnetically (i.e., light) reactive materials. Cells are derived from natural sources or are cultured in vitro. Combinations of different types or categories of cells can be used. Examples of objects include, but are not limited to, cell fragments, cell debris, organelles and other cellular components, tablets, viruses, vesicles, liposomes, capsules, and other structures that serve as an enclosure for molecules. It is to be understood that the composition of the present invention comprises at least one substance. Accordingly, numerous substances or combinations of similar or different substances may be combined with the electroprocessed material. The substances may be combined with the electroprocessed material through electroprocessing techniques or through other techniques. The invention also includes embodiments in which the composition comprises electroprocessed matrix materials without an additional substance. In that embodiment, the electroprocessed matrix materials may act as a substance.

The invention provides numerous uses for the compositions of the present invention. One preferred use is the delivery of substances. Substance delivery from the compositions of the present invention can occur in vivo, for example upon or within the body of a human or animal. Substance delivery can also occur in vitro, for example within a cell culture apparatus or well. Substances delivered include those substances contained within the compositions, other substances produced by the substance contained in the composition, or both. For example, a substance may be a cell contained within the electroprocessed material, and the cell may synthesize and release one or more molecules. Cells may release molecules in response to signals, so that the molecules are released in a specific desired circumstance. For example, an inducible promoter in an engineered cell within an electroprocessed material may be used to stimulate the expression and or release of a growth factor.

The compositions of the present invention are versatile with respect to control of substance release from the compositions. Release kinetics of substances can be controlled by manipulating a wide variety of matrix parameters. In various embodiments, the release rate, onset of release, release of more than one compound either at the same or different times, creation of gradients of release and spatial patterns of release may be manipulated. Compositions that contain electrical or magnetic materials can be influenced to move, cause motion, or produce a biological activity by applying an electric

current or a magnetic field to the composition located on or within a body, or in vitro. Electroprocessed compositions that contain light sensitive components may be designed. These compositions may move or be induced to release or bind substances in response to specific wavelengths of light. Compositions containing nucleic acids or genetically engineered cells, for example, can be used in gene therapy. Other examples include embodiments used in wound care, tissue or organ replacements, and prostheses. In some embodiments, the electroprocessed material itself contains desired properties of substances, and acts as a substance without addition of another substance. The invention thus includes a wide variety of methods of using the compositions of the present invention in medical, veterinary, agricultural, research and other applications. The compositions of the present invention provide safer and more predictable release of substances and provide a major advance in the field of substance delivery, especially drug delivery.

The invention also includes methods for making the compositions of the present invention using any type of electroprocessing technique, combination of electroprocessing techniques, or a combination of an electroprocessing technique and another technique, such as aerosol techniques. The method includes streaming, spraying, dropping or projecting one or more solutions, fibers, or suspensions comprising the materials to be electroprocessed toward a target under conditions effective to deposit the materials on a substrate. The substances to be combined with the electroprocessed materials may be electroprocessed toward the target either before, during or after electroprocessing the material. In this manner, the substance may be incorporated within the electroprocessed material during formation, or may coat the electroprocessed material. Accordingly, one or a plurality of sources of materials and substances is used to provide the ingredients for the electroprocessed composition of the present invention. For example, collagen and a polymer such as poly glycolic acid may be electroprocessed through any combination of electrospinning and electrospraying from two sources. At the same time or at selected times thereafter, substances may be provided from other sources: for example, a third source provides a growth factor, a fourth source provides an anti-angiogenic factor, and a fifth source provides genetically altered fibroblasts. These sources of substances may provide the substances through one or more electroprocessing techniques, such as electrospin, electrospray, electroaerosol, electrosputter or any

combination thereof. These sources may also provide the substances to the electroprocessed material through non-electroprocessing techniques, such as aerosol delivery, dripping, coating, soaking or other techniques.

In one preferred embodiment, the compositions of the present invention
5 comprise one or more electroprocessed materials that form a matrix combined with at least one substance. Either the source or target is charged, and the other is grounded. The substrate upon which electrodeposition occurs can be the target itself or another object of any shape or type. For example, the substrate can be an object disposed between the orifice and the target. In one embodiment, the
10 substrate is a location on or within an organism, such as a tissue, a wound site, a desired location for substance delivery, or a surgical field in which the composition is to be applied. By manipulating process parameters, compositions of the present invention can be manufactured with a predetermined shape, for example, for depositing the material onto or into a molded substrate. Substrate
15 shape can be manipulated to achieve a specific three-dimensional structure. Targets can also be rotated or otherwise moved or manipulated during electroprocessing to control distribution of the electroprocessed material and, in embodiments involving electroprocessed fibers, the orientation of the fibers. Substances included in the composition can be combined with the matrix material
20 by any means before, during, and/or after electrodeposition.

The electroprocessed compositions may be formed into any desired shape. For purposes of substance delivery, the desired shape is dictated by the application. Non-limiting examples include the following: in the form of a patch for application to the skin; in the form of a wafer or tablet for ingestion; in the
25 form of a wafer for application to a site of removal of a glioma; in the form of a wrap to surround a tumor; in a particulate form for spraying on a surgical site; and in a particulate form for delivery of substances through inhalation.

Accordingly, it is an object of the present invention to overcome the foregoing limitations and drawbacks by providing compositions comprising an
30 electroprocessed material and a substance.

Another object of the present invention is to provide compositions comprising an electroprocessed natural material and a substance.

Yet another object of the present invention is to provide compositions comprising an electroprocessed synthetic material and a substance.